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SUBSTITUTE FLUID DAIRY PRODUCTS 1/

Substitutes for fluid dairy products are of 2 general types: (1) Those that use 1 or more components of milk as an ingredient, and (2) those without any milk components. In both instances, the products may have flavor, texture, palatability, and appearance similar to the natural dairy products. But usually their retail prices are significantly below those of their dairy counterparts.

The degree to which substitute products have replaced fluid dairy products cannot be precisely measured, but most observers consider that they have the potential to significantly change the demand for fluid milk. An indication of the possible impact substitutes may have on sales of fluid whole milk may be inferred from experience with coffee whiteners and whipped toppings.

Coffee Whiteners and Whipped Toppings

Dr. Call of Cornell University estimated that non-dairy coffee whiteners have taken 35 percent of the market for light cream 2/. Dr. Call also considers that substitute toppings have taken more than half the total market for whipped toppings. He is supported by data from the 1963 Census of Manufactures, which suggest that 80 percent of whipped toppings were non-dairy products at that time. Federal order data indicate that heavy cream sales dropped about one-fourth between 1956 and 1966.

Prior to the introduction of the substitute whiteners and toppings, coffee cream and whipping cream accounted for about 3 percent of milkfat consumption compared with 2 percent in 1966.

Basic formulas for coffee whiteners and substitute toppings are generally similar. The big difference between these products and their dairy counterparts is the substitution of vegetable fat for milkfat, and soy protein or sodium caseinate for nonfat milk solids. These ingredients are combined with emulsifiers, stabilizers, buffering agents, flavorings, and coloring agents.

Coffee whiteners and whipped toppings are made and sold by both dairy and non-dairy companies. Retail prices for the whiteners are around 24 to 29 cents per pint, while coffee cream prices range between 45 and 49 cents per pint. Non-dairy whipped topping prices range between 35 and 39 cents per pint, compared with 60 to 75 cents per pint for whipped cream in pressurized containers.

1/ Prepared by Herbert H. Meade, Agricultural Economist, Marketing Economics Division, Economic Research Service.

2/ Call, D. L., "Impact of Meat Analogs on the Livestock Industry", Talk at the Cornell Nutritional Conference, Buffalo, N. Y., Oct. 1967, as reported in Feedstuffs, Vol. 39, No. 44, Nov. 4, 1967, p. 74.

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Fluid Milk Substitutes

Substitutes for fluid milk are either: (1) Filled milk, where nonfat milk solids--in either fresh or reconstituted skim milk--are combined with vegetable fat in place of milkfat, or (2) synthetic milk, in which no component of milk is used. Synthetic products may contain sodium caseinate as an ingredient. The Food and Drug Administration considers sodium caseinate to be a chemical product derived from milk, but not falling within the meaning of "dairy products" as defined in the Federal Filled Milk Act.

Filled milk is not new, but the completely non-dairy product is a recent development. Until recently, the sale of filled milks was prohibited by law in 32 States. Recent court litigation and hearings before State regulatory authorities have raised questions concerning the constitutionality of the filled milk acts. Thus, the sale of filled milk is being allowed in more States. Few States prohibit sales of the non-dairy product as long as it meets FDA labelling requirements and standards for wholesomeness. According to a representative of the Food and Drug Administration, FDA is preparing and will soon publish proposals for standards for synthetic milk and cream 1/

Most filled products are made by combining coconut oil, fluid skim milk (or reconstituted nonfat dry milk) and a base mix. Coconut oil, like butter, is a highly saturated fat. However, a major supplier of fats and oils is selling a polyunsaturated fat--a combination of soybean and cottonseed oil--for use in filled or synthetic milk. Filled milk using this fat has been placed on sale in the Midwest. The ingredients listed on packages of filled products, in compliance with State labelling laws, indicate that the base mixes may contain mono- and diglycerides, sodium caseinate, carrageenan, starch, artificial coloring and flavoring. In addition, corn syrup solids and soy protein may be used as a specific ingredient or included in the imitation base mix. The product also may be fortified with vitamins.

1/ Statement at Nutrition, Education, and Dairy Products Promotion Conference, Washington, D. C., April 23, 1968.

Major ingredients in a completely synthetic product are vegetable fat, protein, emulsifiers, buffers, stabilizers, body agents, and sweetener. These products may also contain added vitamins, minerals, and coloring agents. Sodium caseinate is the usual major protein source.

Comparisons of the nutrients in market milk and "synthetic milk" in the Minneapolis market at the beginning of this year are shown in table 20. In this instance, the synthetic milk contained lower levels of most of the listed nutrients than are found in whole milk. This was especially true for protein and calcium.

Both filled and synthetic products sold in other markets were analyzed under the auspices of the National Dairy Council. These tests indicated that the protein, calcium and riboflavin content of filled milk were comparable with that of whole milk. These are the major nutrients which have given milk such an important role in human nutrition. Milk and dairy products supply about three-fourths of the calcium, one-fourth of the protein, and 40 percent of the riboflavin in the average American diet 2/. But the analyses also showed synthetic products to be quite low in these nutrients 3/. Vitamin A was absent in 3 of 4 filled milk samples analyzed, but much higher than that of whole milk in both the other filled milk sample and in the synthetic milk which were vitamin-fortified. Dr. Brink's discussion indicates a number of problems in formulating a product nutritionally equal to milk.

It is believed that these deficiencies can be substantially corrected by changing ingredients (although this may raise costs). However, a question may be raised as to whether consumers consider nutritional differences as important as nutritionists believe they are.

When vegetable fat is used in lieu of butterfat, the fat content of filled or

2/ USDA, U. S. Food Consumption, Stat. Bul. 364, Economic Research Service, Washington, D. C., June 1965, pp. 65-66.

3/ Brink, F. M., "Comparing Nutritional Values of Filled and Imitation Milk," American Dairy Review, Vol. 30, No. 4, April 1968, p. 32.

Table 20.--Nutrients in Market Milk and "Synthetic Milk" 1/

Nutrient	Market milk 2/		"Synthetic milk" 3/	
	Percent	Gm/qt	Percent	Gm/qt
Carbohydrate	4.9	48.00	6.8	66.00
Fat	3.5	34.00	3.1	30.00
Protein	3.5	34.00	0.8	7.3
Ash	0.7	7.0	0.5	4.9
Calcium	0.12	1.15	0.02	0.18
Phosphorus	0.09	0.91	0.05	0.46
Sodium	0.05	0.49	0.07	0.68
Potassium	0.14	1.41	0.36	3.50

1/ Coulter, S. T., and Manning, P. B., presented in speech at New Products Symposium, North Central Milk & Ice Cream Assn., Minneapolis, Minn., January 18, 1968.

2/ Based on the composition of fluid whole milk in Newer Knowledge of Milk, 3rd edition, National Dairy Council, Chicago, Illinois, 1965.

3/ Based on the analysis of a simulated milk product purchased in the Minneapolis-St. Paul market.

synthetic products usually is somewhat lower than the minimum standard for fluid whole milk.

Ingredient Costs: Whole, Filled, and Synthetic Milks

Processing equipment and techniques used in making imitation fluid milk are much the same as those used in processing fresh fluid milk, and distribution also is similar. Therefore, differences in costs between filled milk or synthetic milk and fresh fluid milk arise primarily from differences in raw material costs.

The average U. S. product cost for fluid whole milk of 3.5 percent butterfat is estimated at 27.2 cents per half-gallon (table 21). When nonfat dry milk is used to make filled milk (and compensatory payments are not charged to make its price equal to that of Class I skim milk), the raw product cost for the filled milk is estimated at 14.9 cents per half-gallon. However, when the product is made from fresh skim milk at the average price dealers paid for bottling milk in April, the ingredient cost rises to 20.7 cents per half-gallon. The difference between filled milk using Class I skim milk and whole milk would be 6.5 cents per half-gallon (table 21). But the basic ingredient cost advantage for filled milk using reconstituted nonfat dry milk would be almost twice as large--12.3 cents per half-gallon.

For comparative purposes, a hypothetical formulation for a complete synthetic product is shown in table 22. This example cannot be considered typical of a current product, since soy protein isolate currently is not in general use for synthetic milk.

The total ingredient cost for a completely synthetic product also might vary from the cost estimated in table 22 because the number and types of ingredients may differ among specific commercial formulations.

This estimated ingredient cost of a synthetic milk is 13.0 cents per half-gallon, close to that for filled milk made from nonfat dry milk. If sodium

Table 21--Estimated ingredient costs for filled milk using nonfat powder and Class I fluid skim milk, and for whole milk

Ingredient	Percent of finished product	Estimated ingredient cost per half-gallon, using: Nonfat dry milk 1/	Class I fluid skim milk 2/	Whole milk ingredient cost per half-gallon 2/
		Cents	Cents	Cents
Fluid skim (Class I)	---	---	15.2	15.2
Nonfat dry milk	9.66	9.4	---	---
Vegetable oil	3.00	2.7	2.7	---
Milkfat	---	---	---	12.0
Emulsifiers and stabilizers	.23	2.8	2.8	---
Total solids	12.89	14.9	20.7	27.2
Water	87.11	3/	---	---
Total	100.00	14.9	20.7	27.2

1/ Based upon nonfat dry milk at 24.5 cents per pound, vegetable oil at 21 cents per pound, and base mix (emulsifiers and stabilizers) at about $3 per pound.
2/ Based on the April 1968 price of $6.33 per cwt. dealers paid for 3.5 percent milk and a Class I butterfat differential of 8.0 cents.
3/ Less than 0.01 cent per half-gallon.

caseinate were substituted for the soy protein, the total ingredient cost could be higher, because it sells for about 50 cents per pound compared with 37 cents for soy protein isolate and more sodium caseinate would be required to get the same level of protein content. Sodium caseinate contains about 90 percent protein, instead of the 95 percent in soy protein isolate.

Statutory and Administrative Barriers

The Federal Filled Milk Act of 1923 prohibits the shipment of filled milk products in interstate commerce and defines the components of milk that fall within the provisions of the Act. Filled milk is listed as "any milk, cream, or skimmed milk, whether or not condensed, evaporated, concentrated, powdered, dried, or dessicated, to which has been added, or which has been blended or compounded with, any fat or oil other than milkfat, so that the resulting product is in imitation or semblance of milk, cream, or skimmed milk, whether or not condensed, evaporated, concentrated, powdered, dried, or dessicated." FDA considers that a product containing sodium caseinate (but no other milk component as defined by the Act) is not a filled milk product and may be shipped in interstate commerce.

Over 30 States have laws or regulations prohibiting or regulating the sale of filled milk products within the State. Many of these are patterned after the Federal Filled Milk Act. Since the summer of 1967, State filled milk acts or regulations have been challenged in the courts of at least 6 States: Georgia, Idaho, Washington, Alabama, Arizona, and Texas.

Currently, State laws prohibit the sale of an imitation milk product which contains no milk ingredient other than sodium caseinate in only 5 States: Georgia, Massachusetts, North Carolina, North Dakota, and Utah.

Standards of identity for either filled or synthetic milk have been established by California, Indiana, Louisiana, Mississippi, Missouri, Ohio, and Oregon. Generally, these standards are not as narrow as those for regular dairy products.

Table 22.--Estimated ingredient cost for a hypothetical synthetic milk

Ingredient	Percent of 100 pounds of finished product	Price per pound	Estimated cost per half-gallon of finished product
		Cents	Cents
Fat (coconut oil)	3.00	21.0	2.7
Protein (soy protein isolate, 95 percent protein)	3.50	37.0	5.7
Emulsifiers (sorbitan monostearate)	1.00	40.5	1.7
Buffer (di-sodium phosphate)	.25	9.0	.1
Stabilizer (carrageenan)	.15	165.0	1.1
Body agent (corn syrup solids low D E)	3.50	8.0	1.2
Sweetener (sugar)	1.00	10.8	.5
Water	87.60	---	---
Ingredient cost per half-gallon	100.00	---	13.0

For example, California requires a minimum fat content of 3.0 percent for filled and synthetic milk. However, it sets no nonfat solids minimum, while whole milk is required to have a minimum fat content of 3.5 percent and a minimum nonfat solids level of 8.5 percent.

In fact, standards for many other dairy products, as well as whole milk, appear to be quite narrow and rigid. For example, butter is exactly defined by an Act of Congress and by some State standards, and these prevent development of a lower-fat--and lower-priced--"butter." To permit the development and sale of a part milkfat-part vegetable fat spread in Wisconsin, the State legislature had to pass enabling legislation.

The overall effects of rigid, narrow, and conflicting standards of identity and labelling requirements of the 50 States have been to restrict and reduce dairy product research and development. These restrictions limit the incentive to develop new dairy products.

Current Sales of Filled and Synthetic Milk

Currently, sales of filled and synthetic milk are reported for the Federal order markets and for California and Oregon (tables 23 and 24). In March 1968 about 5.2 million pounds of filled milk was sold by 65 handlers in 30 Federal order markets, about 0.4 percent of total Class I sales in these markets. Synthetic milk was sold in 10 Federal order markets by 15 handlers. In these markets prices of filled and synthetic milk mostly were 5 to 7 cents lower than prices of whole milk. In the continental United States, the Central Arizona market probably has the longest and best documented history of filled milk sales. Filled milk sales during October 1966 in the Central Arizona market were 1.3 percent of regulated pool plants' Class I sales. This share rose steadily to 7.8 percent in March 1968.

In California, filled milk sales in most of 1966 averaged about 0.02 percent of total monthly Class I sales. However,

Table 23.--Filled milk sales in Federal milk order markets, November 1967-March 1968

Year and month	Unit	Filled milk: nondairy fat and 1/		Synthetic milk: nondairy fat, and sodium caseinate and other protein	Total
		Fluid skim milk	Nonfat dry milk		
November 1967					
Number of markets	No.	13	9	3	3/17
Number of handlers	No.	30	11	3	44
Volume	Thou. lb.	1,787	581	2/	2,368
December 1967					
Number of markets	No.	14	9	9	3/24
Number of handlers	No.	33	21	15	69
Volume	Thou. lb.	2,417	912	2/	3,329
January 1968					
Number of markets	No.	15	8	10	3/26
Number of handlers	No.	33	23	14	70
Volume	Thou. lb.	3,083	876	2/	3,959
February 1968					
Number of markets	No.	19	8	12	3/30
Number of handlers	No.	37	22	20	79
Volume	Thou. lb.	3,488	1,078	2/	4,566
March 1968 4/					
Number of markets	No.	19	11	10	3/30
Number of handlers	No.	41	24	15	80
Volume	Thou. lb.	4,118	1,072	2/	5,190
April 1968					
Number of markets	No.				
Number of handlers	No.				
Volume	Thou. lb.				
May 1968					
Number of markets	No.				
Number of handlers	No.				
Volume	Thou. lb.				
June 1968					
Number of markets	No.				
Number of handlers	No.				
Volume	Thou. lb.				

1/ May not include quite all of the sales in these markets. 2/ Unknown. 3/ Represents number of markets reporting sales of one or more products. 4/ Preliminary.

Based on Federal Milk Order Market Statistics.

Table 24.--Markets reporting sales of filled and synthetic milk, November 1967-March 1968

Market	1967		1968		
	November	December	January	February	March
	Filled milk sales, thousand pounds				
Central Arizona	1,587.0	1,687.9	1,863.8	2,280.7	2,766.0
Central Illinois	---	182.9	155.5	165.6	125.5
Cincinnati	1/	1/	1/	1/	1/
Columbus	1/	1/	1/	1/	1/
Corpus Christi	---	---	---	---	1/
Delaware Valley	1/	1/	---	---	---
Fort Wayne	---	1/	1/	1/	1/
Indianapolis	1/	63.6	48.3	1/	1/
Miami Valley	1/	1/	1/	1/	1/
New York-New Jersey	103.8	326.3	498.6	471.3	421.7
North Central Iowa	---	---	---	1/	1/
Northeastern Ohio	1/	1/	216.6	201.6	330.7
Northwestern Indiana	---	---	1/	1/	1/
Northwestern Ohio	1/	1/	1/	1/	1/
Oklahoma Metropolitan	102.4	74.8	98.7	187.5	226.0
Red River Valley	1/	1/	1/	1/	1/
Rock River Valley	---	1/	---	1/	---
St. Louis	---	---	---	1/	1/
San Antonio	---	---	---	---	1/
Southern Illinois	1/	372.0	451.1	462.3	447.1
Tri-State	---	---	---	1/	1/
Upper Chesapeake Bay	---	---	1/	1/	1/
Wheeling	1/	---	---	---	1/
Youngstown-Warren	1/	1/	1/	1/	1/
Total, Federal order markets 2/	2,368.3	3,330.0	3,958.6	4,565.9	5,189.8
California 2/	2,605.1	2,813.8	3,563.7	4,059.8	N.A.
Oregon 2/	508.2	518.2	547.8	549.4	546.6
	Synthetic milk sales 3/				
Appalachian	---	X	---	---	---
Cedar Rapids-Iowa City	---	X	X	X	X
Chattanooga	---	X	---	---	---
Connecticut	---	---	X	X	X
Des Moines	---	---	X	X	X
Duluth-Superior	---	X	X	X	X
Eastern Colorado	X	X	X	X	X
Eastern South Dakota	---	---	X	X	---
Minneapolis-St. Paul	---	X	X	X	X
Nebraska-Western Iowa	X	X	X	X	X
New York-New Jersey	---	X	---	---	---
North Central Iowa	---	---	---	X	---
St. Louis	---	X	X	X	X
San Antonio	---	---	---	X	X
Southern Michigan	---	---	X	X	X
Upper Florida	X	---	---	---	---
California	X	X	X	X	X

1/ Restricted. 2/ May not include quite all of the sales in these markets. California data may include a small amount of synthetic milk. 3/ Checked markets reported sales. Volume of sales not available.

in March 1967, filled milk sales were 0.04 percent and by February 1968 reached 0.9 percent of total fluid product sales. Sales of synthetic milk are not reported.

Oregon presents a somewhat different picture. Imitation milk sales in July and August 1967 were 1.3 percent of total Class I milk sales, and were slightly lower during November 1967-March 1968.

Sales increases of filled and synthetic milk in Hawaii were phenomenal. In August 1967, imitation milk accounted for less than 0.1 percent of Class I sales in the Honolulu market. Heavy promotion and a wide price advantage for imitation milk brought increases in sales each month. By December 1967 sales of imitation milk reached 20.4 percent of Class I sales 1/.

Except during the introductory promotion, prices advertised in Hawaiian newspapers were 39 cents per half-gallon compared with 57 to 59 cents for regular milk.

1/ Division of Milk Control, Hawaii Department of Agriculture, Honolulu, Hawaii.